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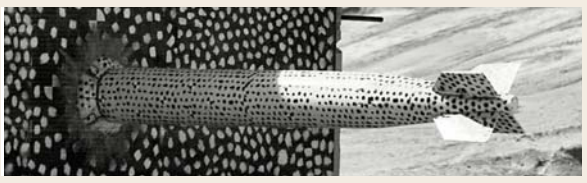
SANDIA ENGINEER David J. Martinez examines the cooling system at Sandia's supercomputing center. See page 5.

Photo by Randy Montoya



B61 test a smashing success

Sandia has sent a mock B61-12 nuclear weapon speeding down the Labs' 10,000-foot rocket sled track to slam nose-first into a steel and concrete wall in a spectacular test that mimicked a high-speed accident. **See page 4.**

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Concrete ideas

Craig Tenney, a chemical engineer, is looking for better ways to clean contaminated concrete after it has been exposed to toxic substances. **See page 7.**

The 'Goldilocks' zone

Fuel cells provide pollution-free power. But, as in the Goldilocks story, membranes in automobile fuel cells work at temps either too hot or too cold. See **page 6.**

That's that

When they were being built in the 1960s and early 1970s, the Twin Towers of New York's World Trade Center were the buildings New Yawwkers loved to hate.

As the buildings crept skyward, everyday folks became instant architecture critics. No one was lukewarm — you either loved them or hated them, with lots more in the latter camp. People on the street, from cabbies to short-order cooks, were more than willing to share their opinions about the havoc these ungainly interlopers were wreaking on their iconic skyline.

The professional critics weren't kind, either; one opined that the buildings looked like steel and glass filing cabinets. They were arrogant. Banal. Another sniffed that the towers looked like the boxes the Empire State Building and the Chrysler Building, those 1930s-vintage art deco masterpieces, came in.

And then a funny thing happened.

As the office spaces filled, as the famed 107th-story Windows on the World restaurant opened, as the towers redrew the skyline, there came first a resigned acceptance, then a grudging regard, and finally, there was, if not love, then at least a unabashed affection for these monoliths. They weren't pretty, but that wasn't the point, was it? Turns out the early critics weren't wrong; just irrelevant.

Once people moved into its spaces, the Twin Towers came alive: That's where Daddy works. Or . . . Look! Way up there — count down to the second row of windows from the top — that's where Mommy works. Or a brother, a sister, a cousin. These buildings were so capacious that practically everybody, even in a city of 10 million, knew somebody who worked there.

They were, when they opened, the tallest buildings in the world. And so, so American. Bigger than life. More about function than form. At first spurned by New Yorkers, they became a symbol of the city, of its aspirations, its energy, its pulse, and even its audacity.

"Journalists and the man on the street will say nice things about it. But architectural critics are cemented in their positions," Angus Kress Gillespie, professor of American studies at Rutgers and author of *Twin Towers: The Life of New York City's World Trade Center*, told a writer for *Salon* magazine in 2001. "I think they did miss the beauty, the way the towers were offset, not side-by-side, and how when you're on a boat on the Hudson River you can see shapes shift between the two [tower] forms. Or how at sunset at Jersey City's Liberty State Park [across the Hudson], the towers' polished aluminum reflected the golden sunshine."

Fifteen years ago this week, on Sept. 11, 2001 — a generation ago now — those lovely, ugly towers, home to some 430 companies employing 50,000 people from 28 countries, were destroyed by coordinated terrorist attacks that claimed 3,000 lives — more than 2,600 at the World Trade Center, 265 on the four airplanes used in the attacks, and 125 at the Pentagon. As the Twin Towers collapsed, reduced to their constituent parts, we knew that the world had changed in some dark and fundamental way.

The loss of life was devastating that day, the nation's response immediate. Within hours of the attacks, leaders in the national security community were already calling on Sandia for help. And we did. As then-Executive VP for National Security Programs Jerry McDowell reflected in the Sept. 9, 2011, 10th anniversary commemorative issue of the *Lab News*, "As a laboratory, we made many contributions to what would become the war on terror. Many of our greatest contributions remain cloaked in secrecy, but you may rest assured that Sandia has made significant contributions to our nation."

In that same issue (http://tinyurl.com/ha62ogw), Labs Director Jill Hruby, who was then Div. 6000 VP and head of the Labs' International, Homeland, and Nuclear Security Strategic Management Unit, noted that strategic decisions made at the Labs in the 1990s positioned us to be there when the nation called.

"Sandians were ready to engage!" Jill wrote, because of activities initiated in the 1990s or earlier to anticipate and address emerging national security threats.

Today, a new tower has risen on the grounds where the Twin Towers fell. One World Trade Center — Freedom Tower — is an impressive structure: At 1,776 feet it's the tallest building on this side of the world. Like its predecessor, it's taken its lumps from the architecture critics, but like its predecessor, it's about much, much more than steel and stone and glass. It's about the lives of those who work there and the lives of those who love and care about them — the lives that we at Sandia strive every single day to protect. For us, it's not a job, it's a calling, a mission, a privilege.

See you next time.

— Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)

2017 Open Enrollment coming soon

Open Enrollment is your annual opportunity to review and update your benefit elections.

- Active Employees: Oct. 31-Nov. 17
- PreMedicare Retirees: Oct. 15-Nov. 18
- Medicare Retirees: Oct. 15 -Dec. 7

* * *

Find out more at **hbe.sandia.gov.**

Retiree deaths

Edward Sweeney (age 86) . . . . . June 9
Mae Lovelace (94) . . . . . June 15
Irene Schulte (84). . . . . June 17
Patrick Long (66) . . . . . June 18
Gary King (74) . . . . . June 24
Peter Richards (81) . . . . . June 25
C. Thomson (90). . . . . June 29
Harold Rarrick (87) . . . . . July 2
Harry Kovaschetz (86). . . . . July 3
Thaddus King (88). . . . . July 3
Maurice Landavazo (87) . . . . . July 4
Robert Duff (94) . . . . . July 5
Louis Wittkopp (80). . . . . July 7
Henry Moeding (102) . . . . . July 8
Howard Gerwin (85) . . . . . July 12
Martel Boyer (85) . . . . . July 12
Richard Knudson (63). . . . . July 12
P. Rogers (88) . . . . . July 15
John Newton (95) . . . . . July 16
Erlinda Marquez (95) . . . . . July 17
Floyd Mathews (80). . . . . July 18
Bruce Worden (87) . . . . . July 19
William Riggan (82). . . . . July 19
Elmond Holbrook (96) . . . . . July 22
Mary Rivenbark (71) . . . . . July 24
Ernest Cordova (89). . . . . July 24
William Wallace (69). . . . . July 27
Willie Romero (93) . . . . . July 29
Paul Mossman (93). . . . . July 31
William Bopp (71). . . . . July 31
Aurora Baca (93) . . . . . Aug. 1
Socorro Silva (91) . . . . . Aug. 1
F. Edward Martinez (74). . . . . Aug. 2
Emanuel Alford (89). . . . . Aug. 2
Ronnie Taylor (72) . . . . . Aug. 6
William Goldrick (89) . . . . . Aug. 12
Robert Armstrong (92). . . . . Aug. 13
Seyfred Toledo (85) . . . . . Aug. 13
Arlene Franke (79) . . . . . Aug. 15
R. Eric Yoder (54) . . . . . Aug. 20
Arturo Lucero (69) . . . . . Aug. 20
Duane Benton (82). . . . . Aug. 21
Robert Cranfill (83). . . . . Aug. 29

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Sandia LabNews

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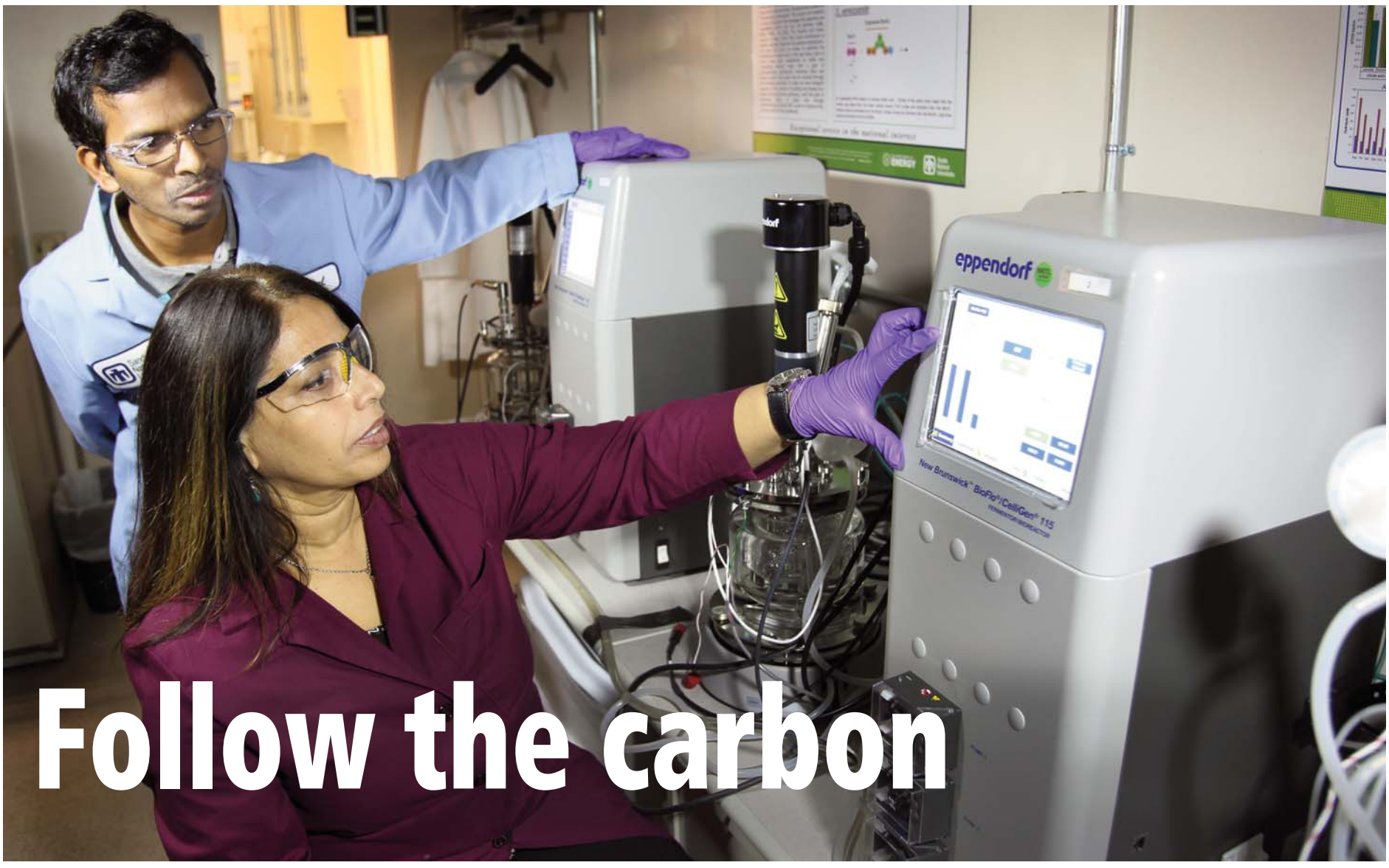
LOCKHEED MARTIN

Deputy Energy Secretary Sherwood-Randall, members of Electricity Subsector Coordination Council, visit Labs

DURING A TOUR OF SANDIA'S ELECTROMAGNETIC PULSE TEST FACILITY, members of a delegation from the Electricity Subsector Coordinating Council (ESCC) listen as Deputy Energy Secretary Elizabeth Sherwood-Randall talks about the R&D role played by DOE's national laboratories in securing the nation's energy grid. Immediately to Sherwood-Randall's right is Sandia Labs Director Jill Hruby. The ESCC, the principal liaison between the federal government and the electric power sector, is responsible for coordinating efforts to prepare for, and respond to, national-level disasters or threats to critical infrastructure. Membership of the ESCC includes representatives from industry and government. Pictured here, from left, are Pat Vincent-Collawn, president and CEO of PNM Resources; Mike Howard, president and CEO of the Electric Power Research Institute; Tom Kuhn, president of the Edison Electric Institute; Mark Gabriel, administrator of the Western Area Power Administration; Jill; Sherwood-Randall; and Sandia Center 6100 Director Carol Adkins. In the background is Juan Torres, chief of operations for Sandia's Energy and Climate programs. (Photo by Randy Montoya)



ARUL VARMAN AND SEEMA SINGH (both 8614) are part of a team that mapped the metabolic pathway of a bacteria that lives solely off lignin. The breakthrough, published recently in the *Proceeding of the National Academy of Sciences*, could lead to economically feasible biofuel production. (Photo by Dino Vournas)

Follow the carbon

Turning ubiquitous lignin into high-value chemicals

Sandia researchers decode metabolic pathway of soil bacterium that thrives on lignin

By Patti Koning

Sandia Exceptional service in the national interest CaliforniaNews

Abundant, chock full of energy, and bound so tightly that the only way to release its energy is through combustion — lignin has frustrated scientists for years. With the help of an unusual soil bacteria, researchers at Sandia believe they now know how to crack open lignin, a breakthrough that could transform the economics of biofuel production.

Lignin is a component of lignocellulosic biomass, the dry plant matter found virtually everywhere. As a biomass source that does not compete with food or feed, lignin is critical to biofuel production. Lignin makes up the fortress-like cell walls of plants to enable water transport against gravity while protecting them from microbial attack and environmental stress. These beneficial traits make lignin hard to break down and even harder to convert into something valuable.

By following the metabolic pathway of an unusual soil bacteria that lives off lignin, Sandia research team members led by principal investigator Seema Singh (8614) believe they can develop technologies to break down lignin and extract valuable platform chemicals. High-value chemicals like muconic acid and adipic acid can be derived from the platform chemicals.

"Lignin is an untapped resource," says Seema. "But as a basis for high-value chemicals, it is of immense value. Those high-value chemicals can be the basis for polyurethane, nylon, and other bioplastics."

The work is reported in a paper titled "Toward Lignin Valorization: How a Soil Bacterium Extracts Building Blocks and Metabolic Energy from Ligninolysis" published Sept. 12 in the *Proceeding of the National Academy of Sciences*. The other authors on the paper are Arul Varman and Weihua Wu (8614); former Sandia interns Rhiannon Follenfant, Sarah Wemmer, and Steve Wrobel; and Lian He and Yinjei Tang of Washington University. The work is funded by Sandia's Laboratory Directed Research and Development program.

Chem production key to biorefinery economics

Biofuels simply don't work as a replacement for gasoline due to the high cost of production.

But if you add the production of high-value chemicals to the biorefinery business model the economics fall into place — just as with the refinery industry, where crude oil is used to produce high-value chemicals and high-volume polymers used in our daily lives.

"Gasoline is a low-value, high-volume product. This is balanced by the high-value chemicals derived from about 6-10 percent of every barrel of oil," says Seema.

Lignin is seen as a byproduct of limited use, typically burned for its energy content. Using biomass for chemical production could yield at least 10 times more value, compared to burning it to make electricity.

Living off lignin

For inspiration on how to break down lignin, the researchers looked to nature.

"We know that over a long period of time fungus and bacteria do eventually break down lignin," says Seema. "If we can understand this process we can use what nature already knows for biofuel and chemical production from lignin."

Since bacteria are easier to engineer for industrial production of desired chemicals, the researchers focused on bacteria. The best candidate was Sphingobium, or SYK-6, found in the lignin-rich waste stream from wood pulp production.

SYK-6 was extremely intriguing because it only feeds on lignin. Microbes generally live off sugar, which is much easier to break down and extract energy from. Imagine a choice between eating a corn kernel or a corn husk.

"In terms of thermodynamics, it doesn't make sense for this bacteria to go after lignin instead of sugar," says Seema. "It does not metabolize sugar so how does it survive? We knew SYK-6 must have a special mechanism to break down the strong linkages of polymeric lignin."

Just as following the money is key to investigating corruption, the researchers set out to follow the carbon to understand how SYK-6 lives off lignin. When the bacteria metabolizes lignin, it ends up via different pathways in various metabolite and building blocks. By following the carbon from start to finish in various networks — a method called metabolic flux analysis — the researchers hoped to map the metabolic pathway.

"This was the first time metabolic flux analysis was used to track lignin metabolism in a microbe," says Seema. "Identifying and locating a labeled source for the carbon substrate that could serve as a realistic surrogate proved very difficult."

Because of the complexity of metabolic pathways, running the experiments did not yield an immediate answer. Singh describes it as "putting together the pieces of a fascinating puzzle driven by analysis."

The Sandia team's paper reports the method used to decipher the metabolic pathway of SYK-6.

Valorizing lignin through chemical production

The next step is to engineer a microbial chassis to harness SYK-6's metabolic pathway. The trick will be to stop the pathway at the right step to extract a useful product. Platform chemicals, which can be used to derive valuable chemicals like muconic acid and adipic acid, are the goal.

One path forward is to genetically engineer SYK-6 to stop its metabolic process at a point when platform chemicals can be extracted from the lignin. Another path would be splice the genes responsible for the important desired metabolic process in SYK-6 onto a strong industrial host like *E. coli* to create a chassis for desired fuels and chemicals. Singh and the other researchers hope to explore both options.

"This understanding casts lignin in a whole new light," says Seema. "Now that we know how to begin deriving value from lignin, a vast resource opens up. Decoding SYK-6 metabolic pathway is providing a roadmap for lignin valorization."

Sled track simulates high-speed accident in B61-12 test

By Sue Major Holmes

Sandia has sent a mock B61-12 nuclear weapon speeding down the Labs' 10,000-foot rocket sled track to slam nose-first into a steel and concrete wall in a spectacular test that mimicked a high-speed accident. It allowed engineers to examine safety features inside the weapon that prevent inadvertent nuclear detonation.

Data analysis from the test continues. Sandia teams will use the information in collaboration with colleagues at Los Alamos National Laboratory to hone their understanding of how systems respond in abnormal environments — accidents or other unexpected events.

The test, part of a B61-12 abnormal environments series, used a test unit that resembled an actual weapon as much as possible, says test director Jason Petti (1383). The high-fidelity unit contained standard components that make up a weapon, explosives, and other hazardous materials, but did not contain any enriched uranium or plutonium, Jason says.

The complex forward ballistic test used rocket motors to accelerate the sled along the track, releasing the B61-12 unit to a free-flight crash. The test met expectations and demonstrated the team's ability to design and implement high-consequence tests. It built on past success for the B61-12 program from 2014 and 2015, when Sandia crashed a rocket sled into a stationary mock weapon in a reverse ballistics test series, considered normal environment tests.

"Abnormal environment tests are performed to benchmark the performance of safety features designed into weapons," says Matt Brewer (2159), lead test engineer. The simulated accident collected data to ensure the weapon met its safety requirements.

Evaluating performance, helping models

Sandia engineers designed the March 9 test both to evaluate the weapon's performance and to calibrate a computer model that predicts what can happen to a weapon under various conditions, Matt says.

John Sichler (2153), lead for the Center Bomb Subassembly Product Realization Team, says designing a weapon system to remain safe even after an accident is extremely challenging.

Test results help improve solid mechanics models, he says. Because tests are expensive and it's not feasible to re-create every possible accident scenario, computer models fill in the gaps by simulating other scenarios.

"We will use the models to predict how our nuclear safety components will perform in numerous postulated accident scenarios without actually conducting tests," John says. "Over the past five years we've been improving our models. It's remarkable how good they have become."

Teams created plans unique to the forward ballistics test to determine how to conduct it safely, establishing safety thresholds and a precedent for future tests, says Heidi Herrera (2159), B61-12 operations lead.

Her role was created to understand and deal with potential hazards. "They needed someone whose sole job is safety to make sure we can do the test safely, securely, and in a quality manner," Heidi says. She helped analyze the hazards, quantified potential risks, and identified ways to control them.

Planning for every contingency

Mike Kaneshige (2500), who worked on explosives safety for the test, says the team had data from past tests and an idea of what to expect. "But the environment we live in is very different than when those tests were done," he says. "The expectation is that we plan for every contingency and have a solid technical basis for the decisions we make."

Matt says analyzing potential chemical, explosive, and mechanical hazards allowed the team to identify "what-can-go-wrong scenarios," such as how a sudden fire might affect the sensitivity of explosives used in the test.

The test unit carried an internal data recorder, hardened so it could measure what happened during the impact and gather data to validate computer models. In the earlier reverse ballistic tests, cables connected sensors and recorders to a stationary test unit. However, the recorder was onboard for the forward ballistics test because it's impossible to attach cables to a unit speeding down a track.

The recorder itself was an engineering feat — it had to be very fast, handle vast amounts of data, and fit into a small space, Matt says. The design will be used in future tests.

The recorder also had its own battery, requiring extra safety oversight since the battery power was compatible with the rocket motors' ignitors, meaning the rocket motor would ignite if there was an electrical path between the battery and the motor's initiator, Jason says. The team built in multiple barriers to prevent unintentional ignition, he says.

'A lot of eyes on it'

The test unit and setup contained numerous hazards, so all components of the system had to be evaluated to ensure safety from installation to impact to recovery. In addition, the system had to perform as designed. "There were a lot of eyes on it," Jason says.

The team developed safety measures for recovering the test weapon and cleanup after the test. Mike says planners discussed such possibilities as damage to the explosives, making them more sensitive and thus more difficult to recover debris. However, safety planners determined that even damaged, the explosives would be within the range Sandia normally handles, he says.

Manager John Wharton (2155) says complex planning went into recovering the unit after the test. "Since we couldn't be positive about how the unit would respond to the impact, we relied on models and informed engineering judgment. That planning paid big dividends during the post-test recovery. The team safely and successfully dealt with myriad post-test hazards including explosive, thermal, chemical, mechanical, and other hazards."

Test preparations also included Emergency Management, which in turn coordinated with the Kirtland Air Force Base Fire Department. Emergency Management thought out what could go wrong so as to mitigate the impacts and be ready to respond to different emergency situations. For example, the plan covered where a helicopter air ambulance could land if needed, where emergency units and an Incident Command would stage, and how to integrate the overall response, say team lead Ricky Romero (42361) and senior manager Richard Newman (4230).

Copperhead program added to safety

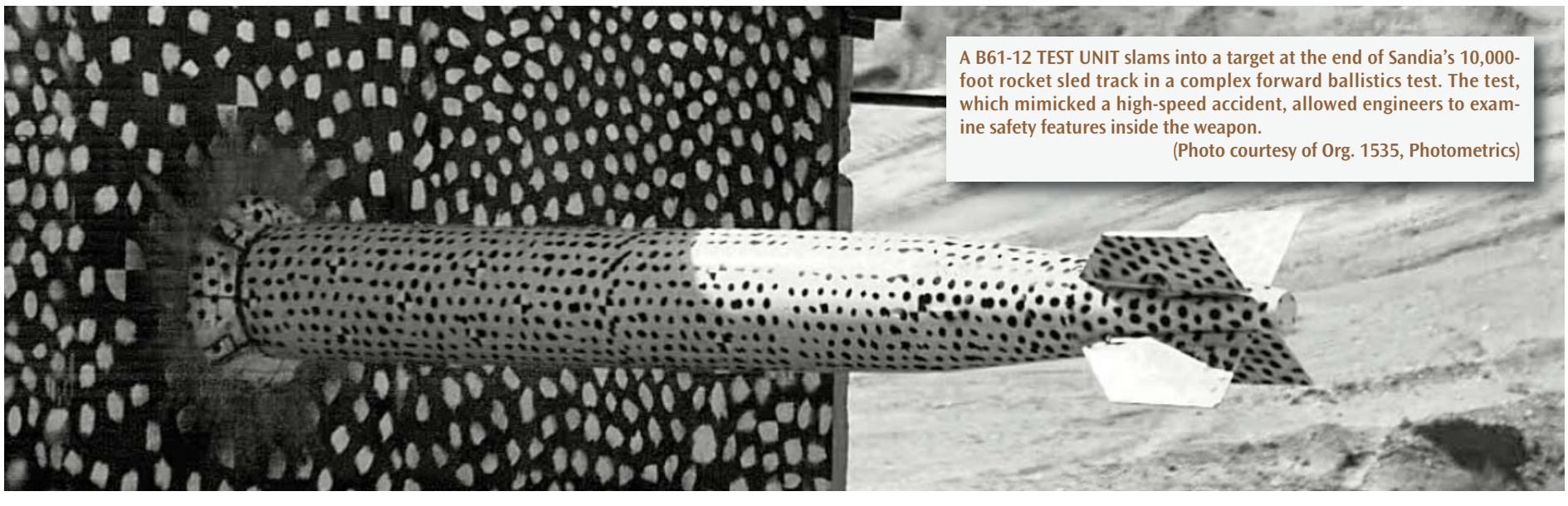
The Copperhead program provided an additional safety measure. Copperhead, Sandia's Mini-Synthetic Aperture Radar (mini-SAR) derivative, is equipped with state-of-the-art coherent change detection capability that can identify extremely small changes in an area where the sensor previously collected information. Copperhead flew over the test area twice while the test was setting up, providing baseline data needed to identify changes after the shot. The system flew again afterward, and, in near real-time, radar imagery analysts at the sled track site were able to give Jason a debris field boundary to help define the area for cleanup and locate any fires.

Test preparations took more than a year. That included a calibration test on the track last December using a B61 trainer, a shell the same weight as a real weapon, to assess plans for the actual test, Jason says. The calibration test proved the test setup and gave the team confidence they could provide the needed impact velocity, he says.

The test was performed in partnership with Los Alamos lab's B61 Life Extension Program Systems Engineering and multiple Sandia organizations including Validation and Qualification (1530), Solid Mechanics and Shock Physics (1550), Explosive Technologies (2550), Advanced Fuzing Technology (2627), Safety Engineering (4120), and B61-12 System Engineering I and II (2120 and 2150).

"It is hard to imagine anything more satisfying for a design team than demonstrating in a test like this that our nuclear safety components performed as designed," John Sichler says.

Heidi and Mike praised the cross-organizational cooperation and coordination, which will carry into future sled track testing. "The level of collaboration and trust was huge," Heidi says.



A B61-12 TEST UNIT slams into a target at the end of Sandia's 10,000-foot rocket sled track in a complex forward ballistics test. The test, which mimicked a high-speed accident, allowed engineers to examine safety features inside the weapon.
(Photo courtesy of Org. 1535, Photometrics)

Internationally known radiation expert named Health Physics Society Fellow

By Heather Clark

GUS POTTER

An internationally recognized expert on the measurement and impact assessment of radiation doses to humans has been named a fellow of the Health Physics Society.

Gus Potter, a certified health physicist since 1997, was honored recently at the annual meeting of the Health Physics Society in Spokane, Washington, for his scientific, educational, and administrative contributions to the profession of health physics.

"I appreciate the recognition for what I've tried to give back to the health physics field and the great opportunities the society has given me," Gus says.

Gus, a distinguished member of Sandia's technical staff, studies the effects and consequences of radiological terrorism and develops system solutions for national security challenges.

In November 2002, Gus became the only person to write an entire issue of the *Health Physics Journal*. The article contained data to help determine radiation doses humans would receive from inhaling more than 90 elements. One of the first of its kind, the tabulated values helped health physicists worldwide more easily calculate doses of inhaled radioactive materials without the need for costly or time-consuming computer codes.

Gus also is the lead author on 17 scientific articles on operational dosimetry, biological research, and national security.

He is a founding member of the DOE Laboratory Accreditation Program's Radiobioassay Oversight Board, which reviews all applications to accredit DOE laboratories to test human waste for radiation.

Gus is "an active and meticulous participant in the deliberations and consistently demonstrated strong technical insight and excellent judgment," writes Steven Snay of the University of Massachusetts Lowell.

Gus has served on the National Council on Radiation Protection and Measurements Working Group to prepare an extensive report on evaluating internal radiation doses. He also has worked with the International Atomic Energy Agency, the International Organization for Standardization, and with many other organizations and industry.

Gus was an instructor at the Health Physics Society's summer schools in 2002 and 2010 and has served as the president of the organization's Rio Grande Chapter. He also worked with the society to hold a midyear symposium in Albuquerque in 2010 and chaired the Local Arrangements Committee for that meeting.

He also is an adjunct professor at the University of New Mexico's Department of Nuclear Engineering where he teaches a graduate-level course on internal radiation dosimetry.

Gus holds a Bachelor of Science in physics from Trenton State College, now named the College of New Jersey. He received a master's and doctorate in radiation health from the University of Massachusetts Lowell.

Supercomputers receive funds to help predict, modify new materials

By Neal Singer

DOE will invest $16 million over the next four years in supercomputers to accelerate the design of new materials.

Luke Shulenburger (1641) will head a team working to improve algorithms that predict and show how to modify materials properties, a key element of the DOE project.

The program will focus on software development that eventually may run on exascale machines, computers able to make more than a billion billion calculations per second.

Paul Kent, director of the Center for Predictive Simulation of Functional Materials at Oak Ridge National Laboratory, explains, "These developments are needed to improve the applicability of today's methods."

The grants announced Aug. 16 are part of DOE's Computational Materials Sciences (CMS) program begun in 2015 as part of the US Materials Genome Initiative. The program reflects the increasing capability of high-performance computers to model and simulate matter's behavior at atomic and molecular scales.

LUKE SHULENBURGER will head a team working to improve algorithms that predict and show how to modify materials properties.

Looking at quantum materials

"We're going to look at quantum materials with novel magnetism, optical properties, and exotic quantum phases that make them well-suited to energy applications in an effort to understand and manipulate these properties," Luke says.

"We're particularly interested in oxides. It's easy to manipulate them to produce different properties," he continues. "But it's expensive to do Edisonian experiments on material after material and potentially easier and more efficient to do those experiments on a computer. That said, the current computational tools we have don't work that well. With this four-year funded project, we intend to extend our capabilities. We've done some calculations with some success, but we need more."

Sandia has a long history in the development and application of electronic structure — that is, solving algorithms quantum mechanically to calculate the properties of a wide variety of materials. Additionally, the Labs boasts considerable expertise in high performance computing, with strong ties to NNSA's Advanced Simulation and Computing (ASC) programs.

The overall research program will combine theory and software development with experimental validation that will take place at multiple DOE Office of Science User Facilities, including the Advanced Light Source at Lawrence Berkeley National Laboratory, the Advanced Photon Source at Argonne National Laboratory, the Spallation Neutron Source at Oak Ridge, and several of the five Nanoscale Science Research Centers across the DOE national laboratory complex, including the Center for Integrated Nanotechnologies at Sandia and Los Alamos national labs.

SUPERCOOL

New cooling method for supercomputers to save millions of gallons of water

By Neal Singer

In different parts of the country, people discuss gray-water recycling and rainwater capture as ways to minimize the millions of gallons of ground water required to cool large data centers. But the simple answer in many climates, says David J. Martinez (9324), is to use liquid refrigerant.

Based on that principle, Dave — engineering project lead for Sandia's infrastructure computing services — is helping design and monitor a cooling system expected to save 4 million to 5 million gallons annually in New Mexico if installed next spring at Sandia's computing center, and hundreds of millions of gallons nationally if the method is widely adopted. The method is currently being tested at the National Renewable Energy Laboratory in Colorado, which expects to save a million gallons annually.

The system, built by Johnson Controls and called the Thermosyphon Cooler Hybrid System, cools like a refrigerator without the expense and energy requirements of a compressor.

Currently, many data centers use water to remove waste heat from servers. The warmed water is piped to cooling towers, where a separate stream of water is turned to mist and evaporates into the atmosphere. Like sweat evaporating from the body, the process removes heat from the piped water, which returns to chill the installation. But large-scale replenishment of the evaporated water is needed to continue the process. Thus, an increasing amount of water will be needed worldwide to evaporate heat from the growing number of data centers, which themselves are growing in size as more users put information into the "cloud."

"My job is to eventually put cooling towers out of business," Dave says.

"Ten years ago, I gave a talk on the then-new approach of using water to directly cool supercomputers. There were 30 people at the start of my lecture, and only 10 at the end.

"'Dave,' they said, 'no way water can cool a supercomputer. You need air.'

"So now most data centers use water to cool themselves but I'm always looking at the future and I see refrigerant cooling coming in for half the data centers in the US, north and west of Texas, where the climate will make it work."

> *"My job is to eventually put cooling towers out of business."*
>
> **— David Martinez**

The prototype method uses a liquid refrigerant instead of water to carry away heat. The system works like this: Water heated by the computing center is pumped within a closed system into proximity with another system containing refrigerant. The refrigerant absorbs heat from the water so that the water, now cooled, can circulate to cool again. Meanwhile, the heated refrigerant vaporizes and rises in its closed system to exchange heat with the atmosphere. As heat is removed from the refrigerant, it condenses and sinks to absorb more heat, and the cycle repeats.

"There's no water loss, like there is in a cooling tower that relies on evaporation," Dave says. "We also don't have to add chemicals such as biocides, another expense. This system does not use a compressor, which would incur more costs. The system instead uses a phase-changing refrigerant and only requires outside air that's cool enough to absorb the heat."

In New Mexico, that would occur in spring, fall, and winter, saving millions of gallons.

In summer, the state's ambient temperature is high enough that a cooling tower, or some method of evaporation, would be used. But more efficient computer architectures can raise the acceptable temperature for servers to operate and make the occasional use of cooling towers even less frequent.

"If you don't have to cool a data center to 45 degrees Fahrenheit but instead only to 65 to 80 degrees, then a warmer outside air temperature — just a little cooler than the necessary temperature in the data center — could do the job," Dave says.

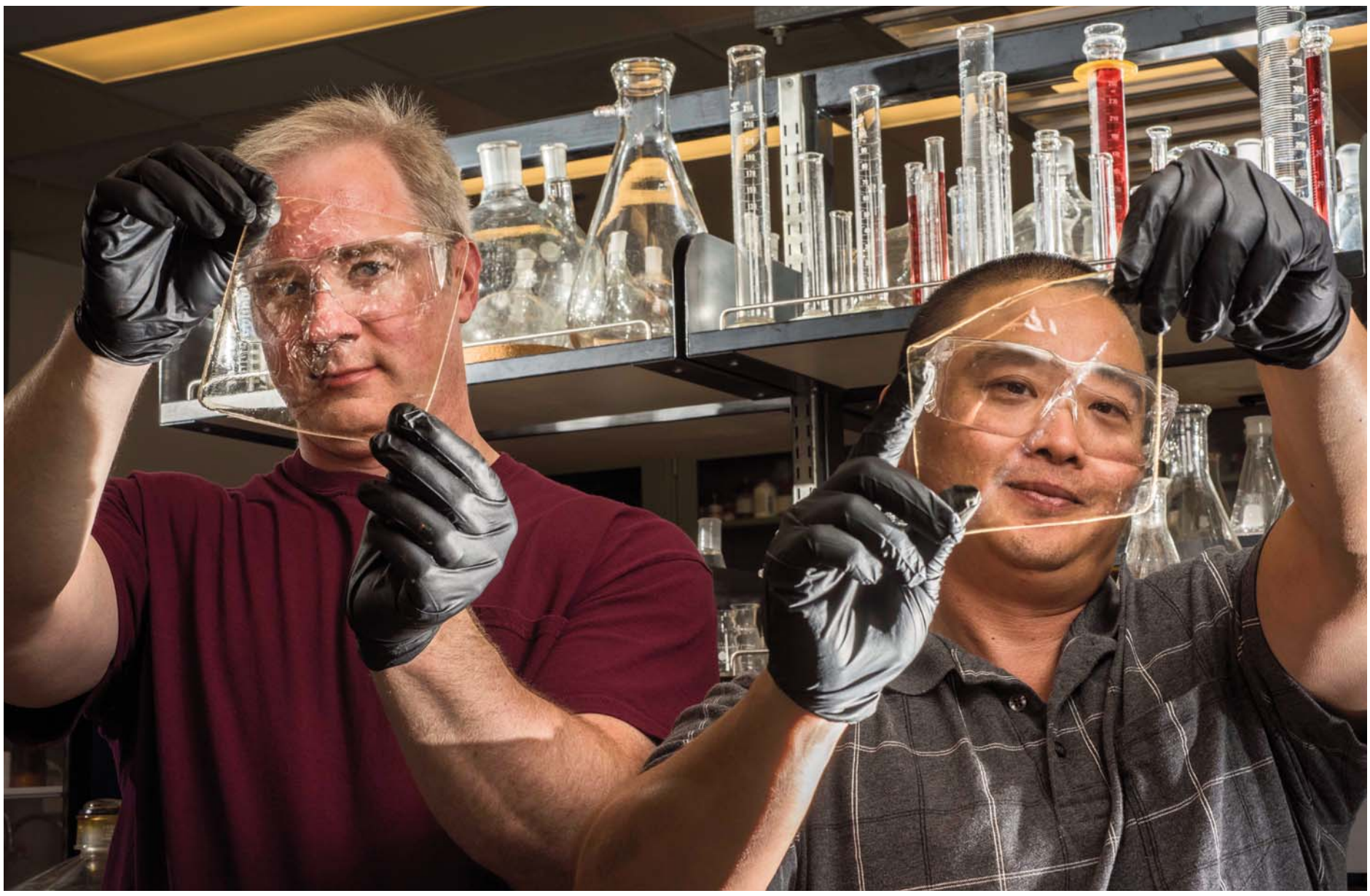
For indirect air cooling in a facility, better design brings the correct amount of cooling to the right location, allowing operating temperature to be raised and allowing the refrigerant cycle to be used more during the year. "At Sandia, we used to have to run at 45 degrees F. Now we're at 65-78 F. We arranged for air to flow more smoothly instead of ignoring whorls as it cycled in open spaces. We did that by working with supercomputer architects and manufacturers of cooling units so they designed more efficient air-flow arrangements. Also, we installed fans sensitive to room temperature, so they slow down as the room cools from decreased computer usage and go faster as computer demand increases. This results in a more efficient and economical way to circulate air in a data center."

In another smart water-saving procedure, big jobs that don't need instant completion can be scheduled at night, when temperatures are cooler.

"Improving efficiencies inside a system raises efficiencies in the overall system," Dave says. "That saves still more water by allowing more use of the water-saving refrigerant system."

Sandia fuel cell membrane outperforms market

'Goldilocks' temperature range just about right



JUST RIGHT — Sandia researchers Cy Fujimoto, right, and Michael Hibbs show the clarity of their recent membranes. (Photo by Randy Montoya)

By Neal Singer

Fuel cells provide power without pollutants. But, like the Goldilocks story, membranes in automobile fuel cells work at temperatures either too hot or too cold to most effectively power automobiles. A polyphenyline membrane patented by Sandia, though, seems to work just about right, says chemist Cy Fujimoto (1853).

The membrane, which operates over a wide temperature range, lasts three times longer than comparable commercial products, say Cy and colleagues in the Aug. 21 issue of *Nature Energy*.

Fuel-cell PEMs (proton-exchange membranes) allow the excretion of protons — the husk, in a sense, of the material providing electrons that form the fuel cell's electrical output. If the protons are not readily provided passage within the cell, the fettered flow reduces the electrical generating output.

Currently commercialized PEMs in most fuel-cell-powered vehicles require water, which means their operating temperature range can't get higher than water's boiling point. Higher temperatures dry out the membrane, increase cell resistance, and reduce performance, says Cy.

"One of the issues with the current PEMs is that you need to hydrate the hydrogen fuel stream for high performance and the fuel cell can't run effectively at temperatures higher than the boiling point of water," he says. "This problem can be solved by employing hydrated fuel streams and having a larger radiator to more effectively dissipate waste heat. Automakers are doing this now. But if PEM fuel cells didn't need water to run it would make things a lot simpler."

Another problem is that material costs for the current membrane of choice can be approximately $250 to $500 per square meter. "DOE would like to see $5 to $20 a square meter," says Cy.

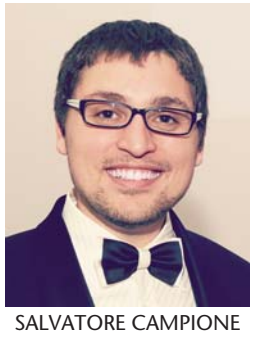
Researchers have attempted to mitigate these problems with a high-temperature method that uses phosphoric acid to dope a polybenzimidazole membrane at 180 degrees C. But the membrane can't operate below 140 degrees without degrading the phosphoric acid. Thus the membrane is unsuitable for automotive applications, where water condensation from cold engine start-ups and other normal reactions at the fuel cell cathode unavoidably bring the temperature down into undesirable ranges that leach the acid out of the reaction.

Now comes the first ammonium ion-pair fuel cell — created at Los Alamos National Laboratory — to combine phosphates with the Sandia-patented membrane. The ammonium-biphosphate ion pairs have exhibited stable performance over a wide range of temperatures from 80-160 degrees C, responded well to changes in humidity, and lasted three times longer than most commercial PEM fuel cell membranes.

"There probably will be industrial interest in this discovery," says Cy. "Our polymer contains a tethered positive charge that interacts more strongly with phosphoric acid, which improves acid retention. Heating the fuel cell and adding humidity doesn't reduce performance."

The fuel cell work was supported by the Fuel Cell Technologies Office of DOE's Office of Energy Efficiency and Renewable Energy.

Salvatore Campione receives IEEE's Outstanding Young Professional Award



SALVATORE CAMPIONE

Salvatore Campione (1352) has been given the 2016 Outstanding Young Professional Award by IEEE honor society Eta Kappa Nu (IEEE-HKN). Salvatore, who received his doctorate in electrical and computer engineering from the University of California, Irvine, in December 2013, is already a senior member of Sandia's technical staff.

A researcher of nanophotonics and metamaterials, with special expertise in periodic structures, leaky-wave antennas, and electromagnetic theory, he was recognized "for his contributions to the electromagnetic modeling of complex systems and structures from microwave to optical frequencies."

Salvatore is listed as author or co-author in more than 50 peer-reviewed journal articles and 80 conference contributions, along with three provisional patents and two book chapters. He has also been selected as a 2013 Marconi Society Paul Baran Young Scholar, a national recognition given to three awardees per year on the basis of academic achievements and leadership in the field of communications and information science.

According to the IEEE-HKN honor society, "The Outstanding Young Professional Award is presented to exceptional young engineering professionals for meritorious service in the interests of humankind, as well as for outstanding achievements in their career."

Notable members of IEEE-HKN, founded in 1904 as HKN at the University of Illinois at Urbana Champaign, include Apple cofounder Steve Wozniak, "Father of the Internet" Vint Cerf, Google cofounder Larry Page, and Intel cofounder and chairman emeritus Gordon Moore.

Salvatore is scheduled to receive his award at the annual IEEE Educational Activities Board Award Ceremony in November in New Brunswick, New Jersey.

A complex problem with concrete

SANDIA CHEMICAL ENGINEER Craig Tenney analyzes modeling results at the John B. Robert Dam in northeast Albuquerque. Craig uses computer simulations to examine how chemicals soak into concrete to better decontaminate concrete structures after an event. (Photo by Randy Montoya)

Cleaning concrete contaminated with chemicals

By Mollie Rappe

In March 1995 members of a Japanese cult released the deadly nerve agent sarin into the Tokyo subway system, killing a dozen people and injuring a thousand more.

This leads to the question: What if a US transportation hub was contaminated with a chemical agent? The hub might be shut down for weeks, which could have a substantial economic and social impact. Craig Tenney (6632), a chemical engineer, is looking for better ways to clean contaminated concrete to reduce those impacts.

"We can't just rip out and replace the affected concrete — that would be too expensive," says Craig. "We need to decontaminate it and make it safe. The public has to be confident enough to come back and use the affected facility."

The project, funded by Sandia's Laboratory Directed Research & Development program, uses computer simulations to examine how chemical agents soak into and bind within concrete. The power of the simulations is that researchers can glimpse details they can't obtain experimentally. Researchers can expose a concrete block to a chemical, try to clean it, and then detect the remaining chemicals, but that doesn't allow them to watch what is happening on the inside, Craig says.

Decontaminating concrete is difficult because it's chemically and physically complex. Craig says he and his team need details of the chemical interactions that occur in concrete so they can design new decontamination methods and mixtures.

Concrete's nitty-gritty details

Concrete has been used since the Roman era and is everywhere: building foundations, sidewalks, even specialized underground seals and linings. But its ubiquity masks remarkable chemical and physical complexity, says Ed Matteo (6222), a chemical engineer with expertise in cement durability.

Like a cake, the recipe for concrete can change depending on how spongy or porous it needs to be, but the major ingredients remain the same. Roasted and finely ground limestone and clay make up the "flour," which is mixed with water to form the gluey "dough" called cement. Concrete is just cement with sand or gravel added to bulk up the mix. Other ingredients can be added to tweak such properties as the time it takes to set.

On the chemical level, cement is made up of many minerals including aluminosilicates from clay, calcium oxide of quicklime, and even potassium hydroxide from potash. But, the most important component is amorphous calcium silicate hydrate, the "glue of the glue," says Ed. Cement loves water and is extremely alkaline. The water contained within cement has a pH of about 13. All this affects how chemical agents react with concrete.

In addition to its chemical complexity, concrete is intricately spongy and thus really hard to clean up. It may not look like it from the outside, but concrete is full of microscopic pores that allow a concrete structure to grab onto chemicals and sometimes "breathe" them back out. That means even if the concrete surface is cleaned, dangerous chemicals from an event could still be hiding deep inside.

Breaking down the problem into bite-sized pieces

Building upon Sandia's long-standing expertise in molecular-scale geochemical simulations, Craig and his team modeled several long-lasting, oily, chemical agents to see how they act within tiny water-loving concrete pores: where they spend their time and how they degrade.

These simulations monitored several chemical molecules wiggling for several nanoseconds in nanometer-sized pores 5,000 to 10,000 times narrower than a human hair. The team validated the simulations against what little experimental data is available, which provided a good starting point.

Building on that knowledge and his expertise in atomic-scale models of chemical reactions, Chris O'Brien (1814), a computational materials science postdoctoral researcher, looked at how chemical agents degrade in concrete. He modeled an agent bound to several different concrete environments and watched how this interaction hastened or slowed the natural break-down process. He plans to expand to other chemicals, time and funding permitting. The team will use the results to determine the best way to decontaminate concrete exposed to nasty chemicals.

Solving the larger problem

Craig and his team still have much to do before they can suggest better decontamination mixtures for concrete, but they have determined how strongly various agents stick to concrete pores, and which ones clump together.

Craig says he would like to team up with geochemists to look at the larger picture. Using information gained from the nanoscale models as a starting point, they would look at larger bits of concrete, still smaller than a human hair, and watch how chemical agents soak into the concrete. Once they understand the transport of chemical agents in concrete, Craig says, they can suggest decontamination mixtures that would move similarly, following an agent to its hiding place within the porous concrete.

One strength of the computer models is that they allow fairly rapid evaluation of different possible decontamination solutions, often much faster than experiments. This will let Craig's team screen many different formulations to see which ones are best at pulling the agents out of the concrete or away from each other. Another goal is to experimentally test these new decontamination methods on concrete contaminated with sample chemicals to validate the insights gained from the computer modeling.

What they learn from the computational models could lead to more accurate field tests, Craig says. Tests that accurately determine the areas impacted by an event and whether the cleaning was effective would improve the efficiency and reliability of decontamination.

"Yes, it would be great from a scientific perspective to just understand what's going on, but from an engineering point of view, it would also be darn nice if we could take that understanding, tailor our approach for decontamination, and make it better," says Craig. "It is a national lab-scale problem and there are lots of little pieces that need to be put together to solve a big problem. So if the unfortunate ever does happen, at least we're prepared."

ZERO HEROES NEEDED

for Pollution Prevention Week September 19–23, 2016

National Pollution Prevention (P2) Week provides an opportunity for individuals, businesses, and government agencies to highlight sustainable activities and achievements, expand current P2 efforts, and commit to new actions. Be a Zero Hero and prevent pollution at Sandia and in your world. Here is a checklist of ways you can be heroic and contribute to P2 each day:

- ☐ Go Green. Go Washable. *Avoid using disposable plastics*
- ☐ Save Energy. *Become a thermostat hawk*
- ☐ Become a Litter Crusader. *Pick up any litter you come across*
- ☐ Take a Spending Break. *Buy only necessities*
- ☐ Turn Off the Tap. *Use less water and save on utility bills*
- ☐ Travel for Less. *Walk, bike, bus, etc. and cut your travel expenses*

ZERO WASTE 2025

ZeroWaste.sandia.gov

REDUCE • REUSE • RECYCLE • BUY GREEN

135 research reactor experts meet in Albuquerque

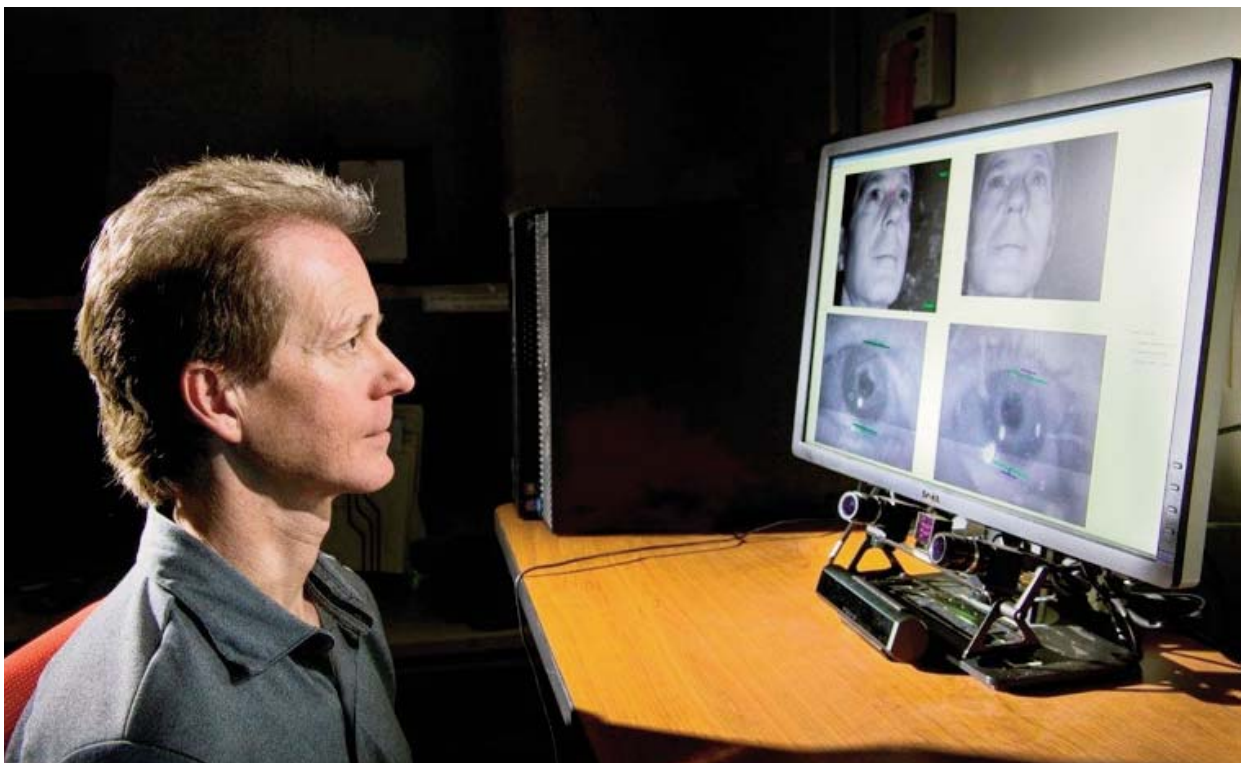
Nuclear Facilities and Applied Technologies Group 1380 and Business Services Dept. 10613 hosted, planned, and sponsored the annual conference of the National Organization of Test, Research, and Training Reactors (TRTR) in Albuquerque in late August.

This year's conference hosted 135 participants and covered current technical and regulatory issues, advances in research and education, and much more. Many of the participants took advantage of the opportunity to tour Sandia facilities in Tech Areas 1, 4, and 5.

TRTR represents research reactor facilities across the nation from government, major universities, national laboratories, and industry. Its missions include education, fundamental and applied research, application of technology in areas of national concern, and improving US technological competitiveness around the world.

A CONFERENCE TOUR of the Annular Core Research Reactor led by Dave Clovis (1381), far right, the facility supervisor. (Photo by Shannon Kawane)

Sandia brings home regional tech transfer awards



SANDIA RESEARCHER MIKE HAASS demonstrates how an eye tracker under a computer monitor is calibrated to capture his eye movements on the screen. Haass and others are working with EyeTracking Inc. to figure out how to capture within tens of milliseconds the content beneath the point on the screen where the viewer is looking. (Photo by Randy Montoya)

Into the marketplace

By Nancy Salem

Sandia won three regional 2016 awards from the Federal Laboratory Consortium (FLC) for its work to develop and commercialize innovative technologies.

The FLC's Mid-Continent/Far West regions recognized Sandia's:

• GazeAppraise: Eye Movement Analysis Software won a Notable Technology Development Award.

• HyStEP: Hydrogen Station Equipment Performance Device won an Outstanding Partnership Award.

• SEARCH: The Selection, Evaluation, and Rating of Compact Heat Exchangers Software Suite won an Excellence in Technology Transfer Award.

The awards were presented Sept. 14 at the FLC Mid-Continent/Far West regional meeting in Albuquerque.

"We want our technologies commercialized for the public good," says Jackie Kerby Moore, manager of Technology and Economic Development Dept. 1933 and Sandia's representative to the FLC. "The FLC awards show that Sandia's work is getting out there and making a difference."

Where the eye is looking

Eye tracking has been used in labs for years to measure where the eye is looking on a computer screen. The images are generally static and not being manipulated as in the workplace. When people interact with dynamic data, it is harder to measure eye movements in relation to visual stimuli, then analyze the data to develop models of perceptual and cognitive activity.

The visual cognition research community has lacked software that models how eyes dynamically recalibrate their trajectory when tracking a moving target across a scene. Sandia's GazeAppraise software characterizes those smooth-pursuit eye movements, creating a new way to evaluate search strategies and human performance.

GazeAppraise will be added to next-generation hardware and software systems used to improve performance in dynamic image analysis applied to medical diagnostics, airport security, nuclear nonproliferation, and other areas where people work with soft-copy images.

A Cooperative Research and Development Agreement (CRADA) with EyeTracking Inc. of Solano Beach, California, has given Sandia access to an array of eye-tracking systems and a path to commercial applications.

"We know a lot about information processing, the physiology and neuroscience of visual processing," says Laura McNamara (5346), an applied anthropologist at Sandia. "How do we take that and apply it in these highly dynamic and real-world environments?"

Speeding up the hydrogen highway

Drivers are seeing more hydrogen fuel cell electric vehicles (FCEVs) on the road, but hydrogen refueling stations are still modest in number, limiting the adoption of this zero-emission technology. The Hydrogen Station Equipment Performance (HyStEP) device is designed to validate the safety and refueling protocols of hydrogen refueling stations and will greatly accelerate commissioning of hydrogen refueling stations in California.

Developed by Sandia and the National Renewable Energy Laboratory (NREL), HyStEP reduces the time to commission new stations from as much as months to just one week. HyStEP is funded by the Department of Energy's Office of Energy Efficiency and Renewable Energy's Fuel Cell Technologies Office as part of the Hydrogen Fueling Infrastructure Research and Station Technology (H_2FIRST) project.

"Industry stakeholders identified station commissioning as a challenge that the national laboratories have the resources to address," says Joe Pratt, the Sandia H_2FIRST project lead. Sandia contracted with Powertech Labs to build the HyStEP device, which was then tested at NREL and is being used by the California Air Resources Board.

FCEVs create no emissions, refuel in less than five minutes and provide a range — upward of 300 miles — on par with gasoline vehicles. Hydrogen FCEVs are on the verge of revolutionizing clean-energy personal transportation. California is the state with the most FCEVs on the road and expects to have 35 operational retail hydrogen stations by the end of 2016. This momentum in clean-energy transportation is fueled by the collaboration between Sandia and NREL on the H_2FIRST project, and Sandia's research expertise in safety, codes and standards for hydrogen technologies.

Heat-transfer efficiency

The micro-channel heat exchanger (MCHE) is an emerging technology that makes power generation, refrigeration, heating, and drilling more efficient. In power generation, even small increases in heat transfer efficiency can greatly boost production and cut the cost of electricity.

Demand for industrial MCHEs has outstripped supply. Until recently, just one company — based outside the US — has done large-scale production of industrial MCHEs. A domestic supplier could reduce costs and increase supply and energy efficiency in a variety of uses.

Sandia's SEARCH is a software suite used to design efficient MCHEs. The design has typically required a combination of analytical performance estimation, computational fluid dynamics, and finite element modeling, with each cycle taking from hours to days. Sandia's simplified design tool uses a sub-heat exchanger thermodynamic model, American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code mechanical constraints, and a thermal-hydraulic solver within the Engineering Equation Solver platform to model any combination of liquid, gas, two-phase, and supercritical fluid.

The Labs partnered with US manufacturer Vacuum Process Engineering (VPE) through a CRADA to commercialize the technology. Sandia licensed SEARCH to the Sacramento, California, company, which has used it to achieve international quality standards, including ASME Boiler and Pressure Vessel Code certification, and enter the MCHE market as a domestic original equipment manufacturer. VPE produces MCHEs in the US and sells them domestically and internationally.

The FLC is a nationwide network of more than 300 members that provides the forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

The FLC Awards Program annually recognizes federal laboratories and their industry partners for outstanding technology transfer efforts. Since its establishment in 1984 the FLC has presented awards to nearly 200 federal laboratories, becoming one of the most prestigious honors in technology transfer.

"GazeAppraise, HyStEP, and SEARCH are great examples of how Sandia's scientific research translates into products that benefit the public," says Mary Monson, senior manager of Industry Partnerships Dept. 1930. "We look forward to working with partners to make these innovations widely available."

FLC
Federal Laboratory Consortium for Technology Transfer

A HYDROGEN STATION EQUIPMENT PERFORMANCE, or HyStEP, device, at right, prepares for testing at a California State University, Los Angeles, hydrogen station. (Photo by Dennis Schroeder/National Renewable Energy Laboratory)

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong


Ed Astle
35 2716


Barry Hess
35 9520


Cliff Renschler
35 2700

Recent Retiree

New Mexico photo by Michelle Fleming


Fred Romo
21 10245


Randy Summers
35 1446


Tom Brown
30 5353


Marv Larsen
30 1514


Kent Meeks
30 100


Angela Ortiz
25 10626


Mabel Pecos
25 2244


Dante Berry
20 2155


Paul Clem
20 1353


Anthony Salazar
20 9517


Robert Abbott
15 6911


Diane Armijo
15 2625


Adele Doser
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Elaine Hinman-Sweeney
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Steven Iveson
15 4127


Vivian Kammler
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Dan Kammler
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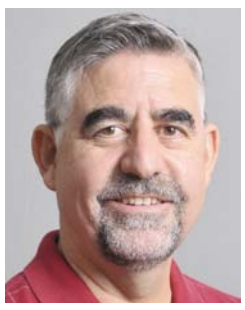
Kevin Kelsey
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Dale Lipke
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Jeffrey Marquez
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Angel Martinez
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Kyle McDonald
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Terry Owen
15 10221


Kevin Pedretti
15 1423


John Richards
15 5448


Scott Rohl
15 256


Crystal Stein
15 9518


Doug Vangoethem
15 1554

Hispanic Heritage Month

Thursday, September 22, 2016
Luncheon @ Mountain View Club
$12 buffet, Beef & Chicken Fajitas
Opening Remarks at 11:30 am
Guest Speaker: Retired Astronaut Sidney Gutierrez

Friday, September 23, 2016
Hardin Field Carnival & 5k Fun Run
Carnival: 3-7pm – Run: 4:15-5pm – Movie: 7:15pm
Run Registration: $15/adult, $10/child (includes t-shirt)
Register Online* or at the Carnival from 3-4pm

Thursday, September 29, 2016
Hardin Field Hispanic Heritage Diversity Awareness Event,
11:00 am – 1:00 pm
Food, Fun, Art and Entertainment

* http://tiny.sandia.gov/7rtnf

SANDIA CLASSIFIED ADS

There will be no Classified Ads in the October 28 Lab News.

MISCELLANEOUS

ANTHROCART COMPUTER DESK, black, curved design, w/multiple adjustable shelves, 60-in. wide, $650 new, asking $250. Cocain, 281-2282.

WAGNER POWER PAINTER PLUS, all manuals, cleaning equipment, used once, project done, $30. Cotter, 205-6599.

SOFA (90-in.), Ethan Allen, loveseat (60-in.), ottoman, brown pattern, excellent, can email photos, $800 OBO. Adams, 934-6294.

MICHAEL KORS PURSE, navy blue, hardly used, like new, excellent condition, paid $400, asking $190. Thorpe, 505-331-1153.

DIGITAL STILL CAMERA, Sony DSC-W330, 14.1-MP, 4x optical zoom, 26 mm wide-angle lens, w/case, never used, $98. Wagner, 505-504-8783.

FISH TANK, 26-gal., matching oak stand, w/fish, filtration station, plants, cave, $125. Garrison, 292-8973.

CARGO BOX, Yakima, $125; Yakima roof-top bike mount & roof rack, 48-in. crossbars, $50. Chirigos, 489-2496.

BED W/FRAME, queen, solid hardwood, 4-poster, headboard/footboard, good condition, $175 OBO. Conrad, 714-609-8975.

DINING TABLE, w/4 chairs, oval, cherry, Ethan Allen, w/2 leaves, can email photo, $850. Maloney, 299-4330, nmjoerita@gmail.com.

LATERAL FILE, oak, single drawer, 28"W x 19"H x 19"D, casters, Pendaflex files, or TV stand w/game storage. Rosul, 900-3678.

DINING TABLE, contemporary, Copenhagen Furniture, 30"H x 38"W x 72-108"L (w/leaves), walnut finish, excellent condition, photos available, $350. Dai, 505-990-9116.

BUNK BED, oak, w/2 mattresses, $275. Marchi, 247-1986.

VINTAGE BLANKET, Chimayo, gray w/multi-color design, ivory fringe, several small spots, photos available, appraised $400, asking $300. Kovarik, 918-3577.

JEANS, Wrangler MWZ, cowboy-cut, blue denim, pressed, women's 7/36-9/38, men's 31/36, like new, $5 ea. Brown, 720-4701.

BICYCLE CHILD CARRIER, Yepp Mini, orange, used once, like new, $60. Beckett, 801-709-4639.

REEL-TO-REEL TAPE RECORDER, TEAC, needs belt, Garrard turn table, Sansui Turner amplifier, instructions, tapes, $225. Williams, 505-271-4902.

KITCHEN CABINETS & COUNTERTOPS, full kitchen, $500/all. Mozley, 884-3453.

LOCAL RAW HONEY, from private hives, $12/pint. Fickling, 505-228-7869, call or text, evenings & weekends only.

EGO ELECTRIC SCOOTER, <1-hp, no license needed, $550. Hubbard, 505-918-6177, 1944anne@gmail.com

PLAYSET, Lifetime Play Center, 1st owner, excellent condition, you haul, paid $1,400, asking $500. Liang, 505-823-1695.

DINETTE/GAME TABLE, finished wood, w/protective surface, 4 cushioned chairs, excellent condition, photos available, $250 OBO. Gutierrez, 505-332-3099.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- **EMAIL: Michelle Fleming (classads@sandia.gov)**
- **FAX: 844-0645**
- **MAIL: MS 1468 (Dept. 3651)**
- **INTERNAL WEB: On internal web homepage, click on News Center, then on *Lab News* link, and then on the very top of *Lab News* homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902.**

Because of space constraints, ads will be printed on a first-come basis.

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

POWERED RECLINING CHAIR, motorized, adjustable headrest, brand new, paid $900 new, asking $600. Lioce, 505-892-8680.

DESK, custom-made by Halberd, knotless hickory, kneehole, 58" x 33", 8 drawers. Schmitt, 856-1280.

ELLIPTICAL, FreeMotion, model 515, like new, $450 OBO; large hammock, w/metal tube, $75 OBO. Brothers, 505-401-6140.

LEARN ABOUT FELINE BREATHING PROBLEMS, Fabulous Felines free lecture, Sun. Sept. 25, http://www.fabulousfelines.org. Stubblefield, 263-3468.

LEAF VACUUM/BLOWER, Workx, several attachments, $50. 2 surround sound amps, $50 ea. Hale, 298-1545.

ROOF-TOP TENT, 3-4 person, ~72" x 96" sleeping area, 3-in. thick foam mattress, excellent condition, $700. Smith, 505-269-1211.

TENNIS BALLS, clean, 5/$1; golf balls, clean, 7/$1; misc. others, cheap. Murphy, 797-8779.

TRANSPORTATION

'04 VOLKSWAGEN JETTA, silver, moon roof, heated seats, 87K miles, $3,700. Reed, 821-7782.

'68 GMC K10, 4x4, shortbed, fleetside, 350 V8, 4-spd. manual, blue patina, $5,500. Leger, 505-506-8968.

RECREATION

'00 HARLEY-DAVIDSON SPORTSTER, multiple HD approved aftermarket parts, $3,500. Erdman, 505-554-5264.

REAL ESTATE

3-BDR. HOME, 3 baths, oversized 2-car garage, 2 living areas, updated kitchen, new carpet, $2,500 toward closing costs, $237,500. Walker, 863-441-3861.

3-BDR. HOME, 2 baths, 1,650-sq. ft., detached garage, RV parking, Los Lunas, FSBO, $188,000. Shiplet, 720-5435.

3-BDR. HOME, 2-1/2 baths, 1,536-sq. ft., beautiful, Rio Rancho, MLS#869849, $163,000. Ramos, 505-730-1900 or 505-220-5201.

4-BDR. HOME, 2,575-sq. ft., mountain views, pool/spa, end lot, NE neighborhood, MLS#870099, reduced price, $339,000. Mason, 505-307-6017.

3-BDR. HOME, 2 baths, beautiful, remodeled, landscaped, 12449 Towner Ave., Tramway/Menaul, call for more info. Lauer, 505-715-8715.

WANTED

HELP WITH QUICKEN, need help understanding & using it. Hamlet, 299-5124.

WORKING EXERCISE BIKE, cheap or free, will pick up. Garner, 505-269-3350.

FLEXIBLE BABYSITTER, for 1 yr. old boy, NE Heights, who can work past 9 p.m. sometimes, work schedule varies weekly. Romero, 505-717-6899.

ROOMMATE, near Copper & Juan Tabo, small dog on site, WiFi/cable available, $450 +1/2 utilities/mo. Galbraith, 269-2889.

WORK WANTED

UNM UNDERGRAD, Navy Reservist, w/references, can house/pet sit, domestic/livestock in Albuquerque area. Chavez, 505-681-9756, ask for Samantha.

Life-saving lessons-learned from Halon incident

With the recent increase in incidents and near-misses involving pressurized canisters and tanks at Sandia and around the DOE complex, the proper care and handling of these systems has become a high-profile safety issue. Knowing this, Anthony Baca, Level 2 manager in Centralized Maintenance Org. 4840, and his team had an idea for a safety lesson when they recently came across an empty old damaged Halon tank with a history all its own.

Partly due to exposure to direct hot sunlight, the gas in this Halon 1301 fire suppression cylinder overheated, expanded, and began to vent violently. As the gases vented, the tank flew about 175 yards (the length of almost two football fields) before bouncing off the ground and hitting a truck. Fortunately, there were no injuries during the event.

Anthony says it was "an obvious choice" to use the damaged cylinder and accompanying poster as the basis for a safety exhibit, which is now being displayed in locations around Sandia to inform members of the workforce about the potential dangers of these systems and help prevent future accidents. The key lessons learned from the Halon incident, Anthony says, are to always safely handle and secure pressurized cylinders and keep them out of the hot sun. If you do see a problem, call 311 (or from a cell phone 844-0311).

— Anthony Baca (4840) and Norb Tencza (4878)

FREDDIE MARTINEZ, left, and Jeff Butler (both 4843-2) examine the red Halon 1301 fire suppression cylinder that was involved in a 2012 venting incident at Sandia. Freddie and Jeff helped fabricate and assemble the traveling cylinder safety exhibit. (Photo by Randy Montoya)

Meet Sandia's 2017 Truman Fellows

Boosting Sandia research in advanced manufacturing, materials science, biological imaging

This year, three individuals will join the Truman Fellow ranks: Adam Backer, Nicholas Burtch, and Matthew Hudspeth. They join the ranks of 22 other Fellows who have been appointed since Sandia's President Harry S. Truman Fellowship in National Security Science and Engineering was established in 2004.

Because the fellowships are three-year assignments, four Truman Fellows are still doing research at Sandia as part of their fellowship. Additionally, 16 other Truman Fellows subsequently joined the Labs' technical staff upon completion of their fellowship assignments, 10 of whom are still researchers at Sandia.

Nick received a PhD in chemical engineering from Georgia Tech in June. His proposed Truman project focuses on engineering zero-thermal-expansion components for advanced manufacturing technologies. He is skilled at materials modeling, structure prediction, and density of states, and uses vast materials databases for validation. His work complements and fits well with the portfolio of metal organic frameworks research at Sandia's New Mexico and California sites. Nick joined Energy Nanomaterials Dept. 8341 in August, with Andy Vance as his manager and Dave Robinson as his mentor.

Matt earned his PhD in aeronautics and astronautics from Purdue University. His groundbreaking doctoral work focuses on understanding the performance of fibers used in body armor. His research includes the use of modeling and simulation and experimental imaging to provide new understanding of this issue. Matt's proposed Truman research will help understand the damage to metals that occurs under high-strain-rate processes to be able to better inform high-strain-rate deformation models. Matt will join Experimental Environmental Simulation Dept. 1528 in October, with Darrick Jones as his manager and Bo Song as his mentor.


ADAM BACKER

Adam earned his PhD in computational and mathematical engineering at Stanford University in June. As a Truman Fellow, he proposes to develop a hyperspectral superresolution capability and use this to study the toll-like receptor signaling to understand the mechanisms of immune response to pathogen exposure. Sandia's research on biological responses to pathogens and Adam's proposed technology would result in a new, mission-relevant method capable of advancing the Labs' landmark hyperspectral imaging technology to simultaneously perform three-dimensional spectral and molecular orientation measurements inside living cells with nanometer spatial resolution. Adam will join Bioenergy and Defense Technology Dept. 8631 in October, with Jim Carney as his manager and Jerilyn Timlin as his mentor.

Sandia Div. 1000 VP and Chief Technology Officer Rob Leland (1000) says, "The number and caliber of the candidates was excellent again this year, making the selection committee's job a difficult one. I am delighted with the results and look forward to learning more about these individuals and their research once they are on board. The Truman Fellows program, now in its 12th year, continues to be an unparalleled opportunity for researchers to develop new and innovative ideas while helping us advance our capabilities in areas of fundamental importance to our research foundations."

The *Lab News* recently asked each Truman Fellow to describe the work he intends to pursue at Sandia. Here's what they had to say:

Adam Backer

In recent years, the fluorescence microscope has revolutionized the field of biological imaging. Using newly developed experimental techniques combined with cutting-edge data analysis strategies, it is now possible to image live cells and macromolecules such as DNA in all three spatial dimensions with unprecedented clarity and precision. Current microscopy applications have fine enough sensitivity to detect single fluorescent molecules, and are able to image biological structures with detail an order of magnitude smaller than the wavelength of light — a feat termed "super-resolution." These combined advances have established the fluorescence microscope as a premiere non-invasive technology for studying biochemical processes as they occur inside living organisms.

As a Truman Fellow at Sandia, I intend to develop a multimodal imaging platform that enables the spectra (color), polarization, and excited state lifetime of fluorescent probes to be determined in parallel, without compromising the speed, sensitivity, or resolution with which images are acquired.

Measurement of these additional physical parameters, combined with super-resolved imaging, will enable biologists to simultaneously observe multiple organelles within a single cell and monitor their interactions in real-time.

In collaboration with other researchers at Sandia, this novel microscope system will be used for understanding the immune response pathways activated by white blood cells in response to pathogen exposure, and will also be used as a tool for detecting DNA conformation changes that occur as a result of externally applied mechanical forces.

Furthermore, this project will benefit from the nanofabrication capabilities available at CINT [the Sandia/Los Alamos Center for Integrated Nanotechnology] to realize ambitious optical designs not achievable using conventional materials, as well as Sandia's high-performance computing resources for processing large, multiparametric image datasets.

The funding and mentorship provided by the Truman Fellowship presents an unparalleled opportunity to work with top scientists and embark on groundbreaking work in the physical and life sciences. I look forward to starting my career at Sandia!

Nicholas (Nick) Burtch

An increase in temperature leads to an increase in volume in most materials. In other words, most materials exhibit positive thermal expansion. However, for applications where materials are placed in confined environments, positive thermal expansion can lead to significant material stress or even catastrophic device failure. Positive thermal expansion at material interfaces can also lead to cracking and peeling. The ability to impart near-zero thermal expansion properties in a wide array of material designs via additive manufacturing technologies would mitigate such issues and bring significant value to Sandia's materials science and engineering capabilities.


NICK BURTCH

As a Truman Fellow, I will engineer and design nanoporous materials such as metal-organic frameworks and zeolites as negative thermal expansion fillers that can robustly compensate for the positive thermal expansion of existing materials.

While the constituent building blocks in nanoporous materials generally exhibit positive thermal expansion, the void spaces within their structures can allow various "wiggling" and "twisting" modes among these building blocks that cause the overall material to display negative thermal expansion. By understanding these negative thermal expansion mechanisms, promising material candidates can be identified and exploited as negative thermal expansion fillers in additive manufacturing technologies such as binder jetting to create near-zero thermal expansion composites.

Sandia is the perfect environment for pursuing this work because of its world-class facilities and depth of expertise in both additive manufacturing and nanomaterial synthesis and characterization.

Matthew (Matt) Hudspeth

When designing common structures, engineers typically assume elastic behavior of a constituent material, thereby requiring implementation of a prodigious safety factor to mitigate possible failure. While such a cautious design is prudent in nature, many advanced systems are asked to deform beyond their elastic regime when subjected to abnormal environments such as fluctuations in temperature, high strain-rates, or progressive aging. Thus, the classic aforementioned design procedure of relying on an ample safety margin is rendered insufficient in extreme applications, forcing designers to predict system behavior using advanced material models.


MATT HUDSPETH

Yet herein lies the crux of the structural design insufficiency: in order to develop high-fidelity material models, appropriate understanding of local damage mechanisms must be available for the specific complex loading conditions subjected onto the system of interest, which for current structural deformation modeling is often unavailable for all but simple quasi-static loading procedures.

At Sandia, I hope to extend the current understanding of damage progression in materials subjected to abnormal conditions, specifically high strain-rate loading. Ultimately, the focus is directed at providing the deformation physics required for high-fidelity modeling environments, thereby drastically decreasing the cost of future structural design.

Unhindered by common financial impediments, the Truman Fellowship offers an unmatched research opportunity allowing for unfettered levels of collaboration with world-renowned scientists whose guidance not only increases the likelihood of impactful solutions, but aids in the growth of critical leadership capabilities and research skills required to lead a successful research team. The Truman Fellowship provides for a unique opportunity to become integrated into the Sandia system, and I am honored to be afforded such an opportunity to grow within the nation's premier research institute.

President Harry S. Truman Fellowship
in National Security Science and Engineering

The Truman Fellowships are three-year appointments. Candidates are expected to have solved a major scientific or engineering problem in their thesis work or have provided a new approach or insight to a major problem, as evidenced by a recognized impact in their field. The program, which fosters creativity and stimulates exploration of forefront science and technology and high-risk, potentially high-value R&D, is funded by Sandia's Laboratory Directed Research and Development (LDRD) Program. A panel of senior scientists/engineers and one Fellow reviews and ranks each application, interviews finalists, and makes a hiring recommendation to the CTO, 1000. Applications are currently being taken for the FY2018 application deadline of Nov. 1, 2016.

The 2017 panelists were: Cynthia Phillips (Chair, 1400); Joe Michael (1800); Philip Kegelmeyer (8900); Ed Cole (1000); Randy Cygan (retired), Tina Nenoff (1100), Tan Thai (5600); Phil Dreike (5700); and Michael Desjarlais (1600).

Sandia's CTO Programs Office (1911) and Human Resources (3555) teamed more than 10 years ago to create the Truman Fellowship Program and develop the processes necessary to implement the prestigious position.

Truman Fellows in FY16 were Grey Ballard (8962), John Gamble (1425), Julia Ling (8253), and Mike Martin (1728).

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UNITED WAY

United Way Information Fair
October 3 • 11am — 1pm
Steve Schiff Auditorium Lobby

Learn about United Way programs and Sandia affinity groups.

Attendees can earn 1000 Virgin Health Points.

Lunch items for purchase.

United Way
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